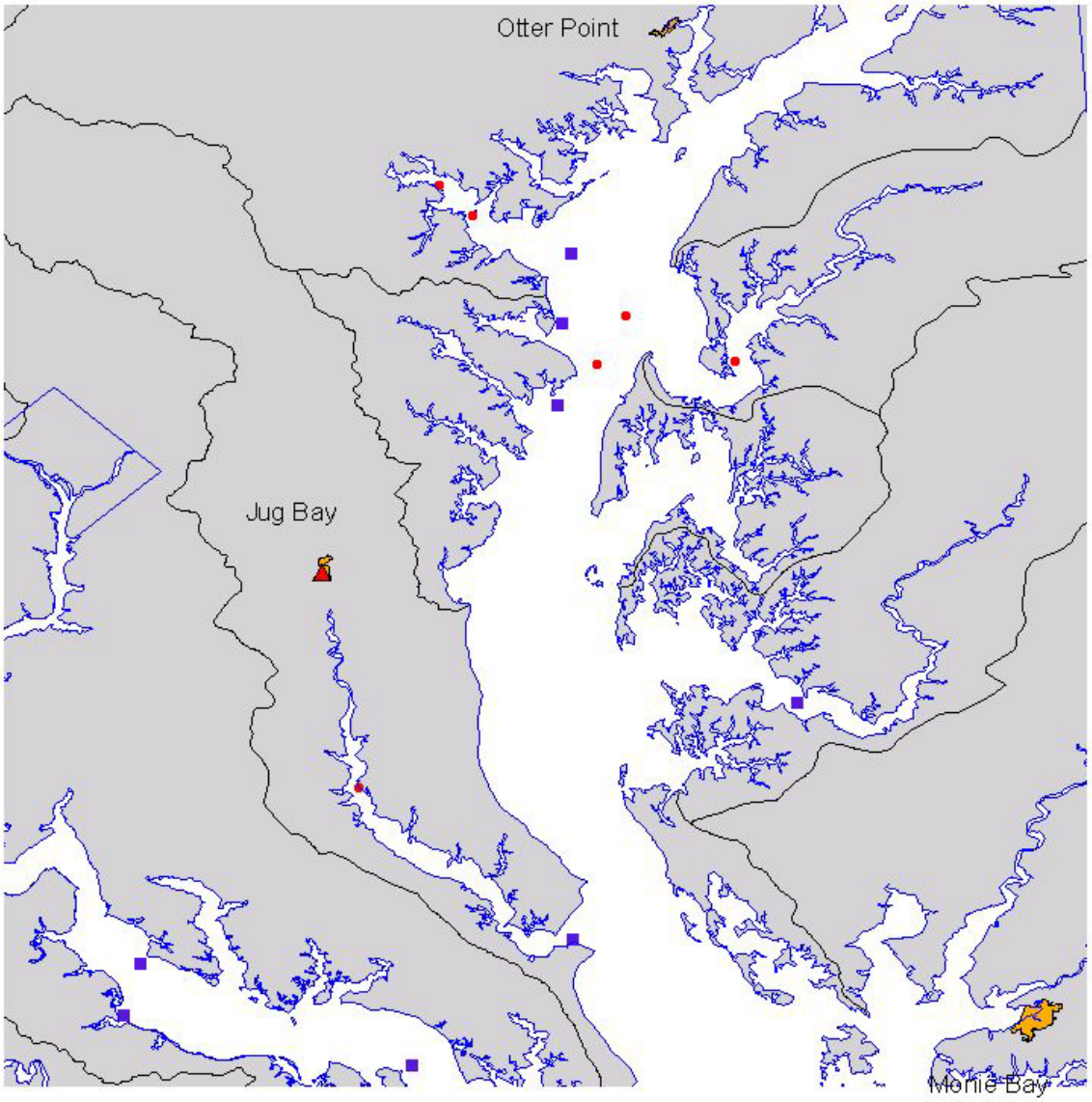
Chesapeake Bay, MD



Chesapeake Bay Maryland, Jug Bay (CBMJB)

Characterization (Latitude = 38° 46' 00" N; Longitude = 76° 42' 30" W)
This site is in a shallow tidal marsh creek in the upper reaches of the Patuxent River. Tides at Jug Bay are semidiurnal and average 0.75 m in range. The creek has an average width of 5 m. Creek bottom habitats are silt-clay with no bottom vegetation. Marsh vegetation near the sampling site includes wild rice, cattails, arrow arum, arrowhead, cattails, pickerelweed, spatterdock, rose mallow, and *Phragmites* sp. One of the most important plants in the tidal wetlands is wild rice. The dominant upland vegetation includes mixed hardwood forest of oaks, hickory, sweet gum, American beech, poplars, red maple, sassafras, and Virginia pine. The sub-canopy contains American holly, sweet bay, musclewood, flowering and silky dogwood, witch hazel, smooth alder, red maple, and black gum. Upland land use near the sampling site includes a park, residential development, and agriculture. Activities that potentially impact the site include nutrient inputs from sewage treatment plants and non-point source runoff.

Descriptive Statistics
Twenty-three deployments were made at this site between Apr-Sep 1996, Jul-Nov 1997, and Jun-Sep 1998 (Figure 86). Mean deployment duration was 11.9 days. Only two deployments (Jun, Jul 1996) were less than five days.

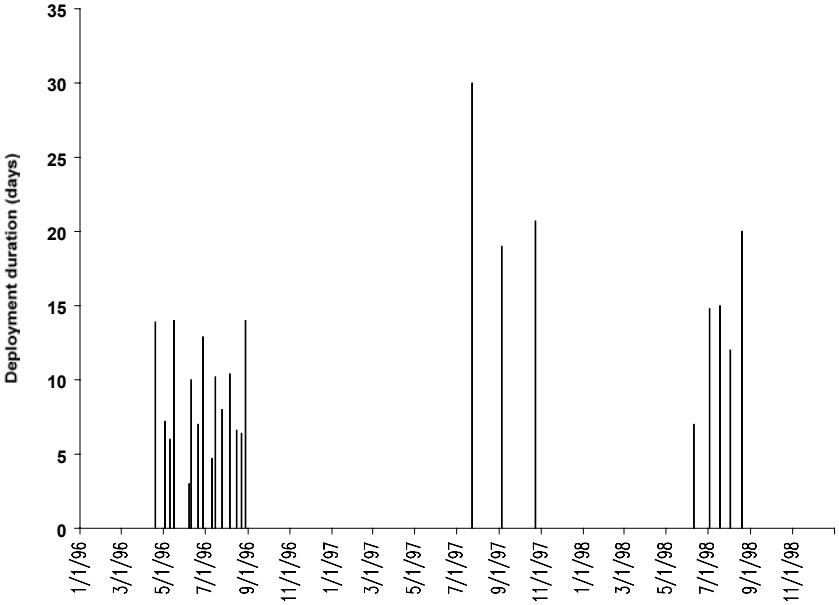


Figure 86. Chesapeake Bay MD, Jug Bay deployments, 1996-1998.

Twenty-four percent of annual depth data were included in analyses (37% in 1996, 18% in 1997, and 19% in 1998). Sensors were deployed at a mean depth of 0.6 m below the water surface and 0.1 m above the bottom sediment. Moderate fluctuation (0.75-1 m) in water depth was evident for daily and bi-weekly cycles from scatter plots. Harmonic regression analysis attributed 94% of depth variance to 12.42 hour cycles, and 3% of depth variance to both 24 hour cycles and interaction between 12.42 hour and 24 hour cycles.

Twenty-four percent of annual water temperature data were included in analyses (37% in 1996, 18% in 1997, and 19% in 1998). Water temperature likely followed a seasonal cycle; however, winter water temperatures were unknown (Figure 87). Mean water temperature in Jul-Sep 1996-1998 was 25-27°C. Minimum and maximum temperatures recorded between 1996-1998 were 4.6°C (Oct-Nov 1997) and 36.7C (Jun 1996), respectively. Scatter plots suggest strong fluctuation (2-10°C) in water temperature at both daily and bi-weekly intervals. Harmonic regression analysis attributed 51% of water temperature variance to 24 hour cycles, 35% of temperature variance to interaction between 12.42 hour and 24 hour cycles, and 14% of variance to 12.42 hour cycles.

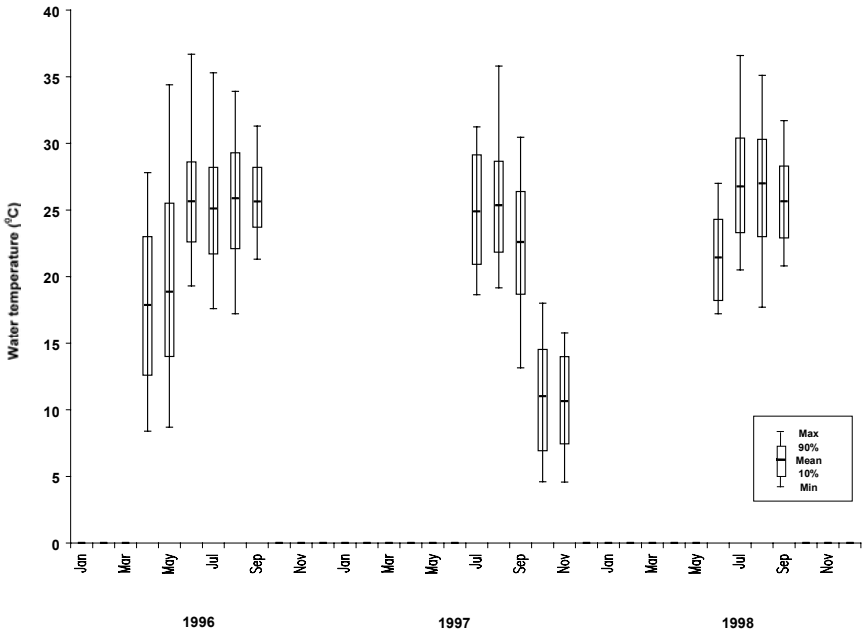


Figure 87. Water temperature statistics at Jug Bay, 1996-1998.

Twenty-four percent of annual salinity data were included in analyses (37% in 1996, 18% in 1997, and 19% in 1998). Absolute values for salinity were between 0-0.4 ppt. Salinity followed no apparent seasonal cycle. Harmonic regression analysis attributed 38%, 33%, and 29% of salinity variance to 12.42 hour cycles, 24 hour cycles, and interaction between these two cycles, respectively.

Thirty-one percent of annual dissolved oxygen (% saturation) data from 1996 and 15% of dissolved oxygen (% saturation) data from 1998 were included in analyses; no dissolved oxygen data were collected in 1997. During Apr-Sep 1996, mean dissolved oxygen varied between 42% saturation (Jul) and 66% saturation (Sep). In Jul-Aug 1998, mean dissolved oxygen readings varied between 33-40% saturation. Minimum and maximum DO recorded in 1996 was 0% saturation and 231% saturation, respectively. Hypoxia was observed during every month (except Apr 1996) and persisted for 22.1% of the first 48 hours post-deployment on average (Figure 88). Supersaturation was also observed every month (except Jul 1996) and persisted for 8.3% of the first 48 hours post-deployment on average. Scatter plots suggest strong (80-200%) fluctuation in DO readings at daily and bi-weekly intervals. Harmonic regression analysis attributed 59% of DO variance to interaction between 12.42 hour and 24 hour cycles, 27% of DO variance to 12.42 hour cycles, and 14% of DO variance to 24 hour cycles.

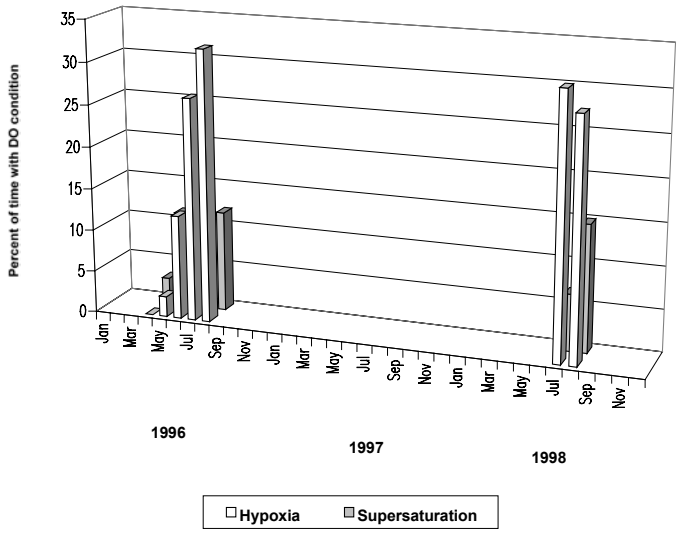


Figure 88. Dissolved oxygen extremes at Jug Bay, 1996-1998.

Photosynthesis/Respiration

Over three quarters (76%) of the data used to calculate the metabolic rates fit the basic assumption of the method (heterogeneity of water masses moving past the sensor) and were used to estimate net production, gross production, total respiration and net ecosystem metabolism (Table 22). Instrument drift during the duration of the deployments was not a significant problem at this site. Respiration rates exceeded production rates at Jug Bay; thus, the net ecosystem metabolism and P/R ratio indicated that this is a very heterotrophic site (Figure 89). Temperature was significantly ($p<0.05$) correlated with total respiration and net ecosystem metabolism. Respiration increased as temperature increased, while net ecosystem metabolism became more heterotrophic as temperatures increased. Salinity was significantly ($p<0.05$) correlated with net ecosystem metabolism, but not gross production or total respiration. Net ecosystem metabolism became more heterotrophic at higher salinity.

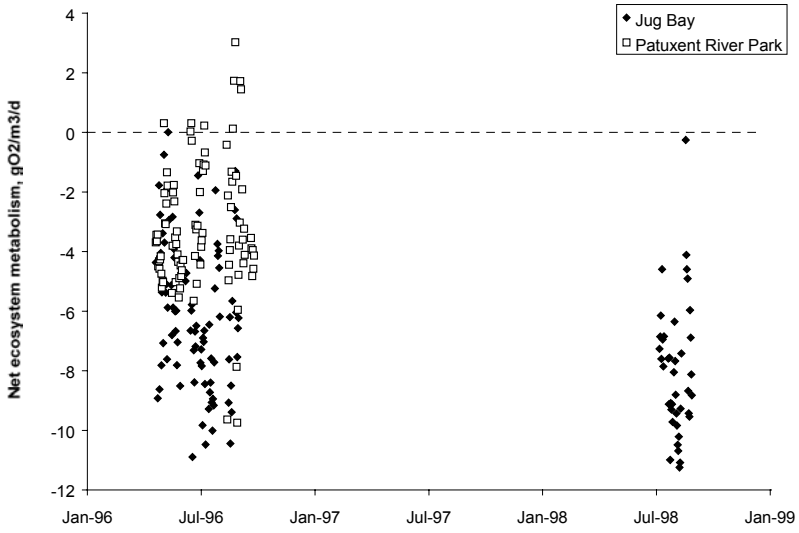


Figure 89. Net metabolism at Jug Bay and Patuxent River Park, 1996-1998.

Table 22. Summary of metabolism data and statistics for Jug Bay, 1996-1998.

Jug Bay	mean	s.e.
Water depth (m)	0.73	
Net production $gO_2/m3/d$	-1.08	0.36
Gross production $gO_2/m3/d$	10.22	0.70
Total respiration $gO_2/m3/d$	19.29	0.71
Net ecosystem metabolism g $O_2/m3/d$	-9.07	0.28
Net ecosystem metabolism g C/m2/y	-651	
P/R	0.53	
Statistical results		
Drift – paired t-test		
Gross production	ns	
Total respiration	ns	
Net ecosystem metabolism	ns	
Percent useable observations	76	
Paired t-test on gross production and total respiration	p<0.001	
Correlation coefficient	Temperature	Salinity
Gross production	ns	ns
Total respiration	0.23	ns
Net ecosystem metabolism	-0.38	-0.34

Chesapeake Bay Maryland, Patuxent River Park (CBMPR)

Characterization (Latitude / Longitude: 38° 46' 00" N, 76° 42' 30" W)
This site is located in the upper reaches of the Patuxent River near Jackson Landing on the west flank of the river. Tides in the river are semidiurnal and average 0.75 m in range. The Patuxent River is 175 km long (mainstream linear dimension), has an average depth of 5 m MHW, and an average width of 750 m. At the sampling site, the width is 50 m. This site is in the main channel of the river. The bottom sediment is silt-clay with no bottom vegetation. The dominant marsh vegetation near the sampling site includes cattails and wild rice. The dominant upland vegetation is mixed hardwood forest. Upland land use near the sampling site includes residential development and farming. Activities that potentially impact the site include nutrient inputs from sewage treatment plants and non-point source runoff.

Descriptive Statistics
Twenty-six deployments were made at this site between Apr-Sep 1996, Jul-Nov 1997, and Jun-Aug 1998 (Figure 90). Mean deployment duration was 11.3 days. Only three deployments (May, Jun, Jul 1996) were less than 5 days.

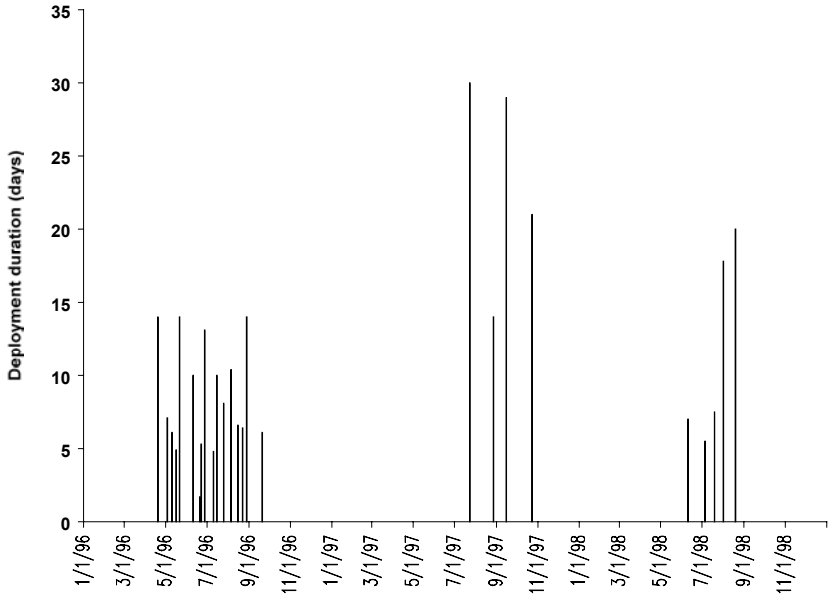


Figure 90. Chesapeake Bay MD, Patuxent River Park deployments (1996-1998).

Twenty-seven percent of annual depth data were included in analyses (39% in 1996, 26% in 1997, and 16% in 1998). Sensors were deployed at a mean depth of 2.3 m below the water surface and 0.1 m above the bottom sediment. Moderate fluctuations (0.5-1 m) in daily and bi-weekly water temperature were evident from scatter plots. Harmonic regression analysis attributed 92% of depth variance to 12.42 hour cycles and 4% of depth variance to both 24 hour cycles and interaction between 12.42 hour and 24 hour cycles.

Twenty-six percent of annual water temperature data were included in analyses (39% in 1996, 26% in 1997, and 14% in 1998). Water temperature likely followed a seasonal cycle; however because water temperature data were only collected between Apr-Nov, true amplitude of such a seasonal cycle could not be determined (Figure 91). Mean water temperature in Jul-Sep 1996-1997 was 24-26°C, slightly lower than mean water temperature in Jul-Sep 1998 (26-28°C). Minimum and maximum temperatures recorded between 1996-1998 were 7.6°C (Nov 1997) and 30.5°C (Jul 1998), respectively. Scatter plots suggest moderate fluctuation (<2°C) in daily water temperature cycles and strong fluctuation (≥5°C) in bi-weekly temperature cycles. Harmonic regression analysis attributed 43% of temperature variance to 24 hour cycles, 36% of temperature variance to 12.42 hour cycles and 21% of temperature variance to interaction between 12.42 hour and 24 hour cycles.

Twenty-six percent of annual salinity data were included in analyses (39% in 1996, 26% in 1997, and 14% in 1998). Absolute values for salinity were between 0-1 ppt. Mean salinity was greatest in 1997 (>0.2 ppt). Salinity readings were fairly constant at daily and bi-weekly intervals. Harmonic regression analysis revealed that variance in salinity, although very minor, was primarily (91%) attributed to 12.42 hour cycles. Twenty-four hour cycles only accounted for 2% of salinity variance and interaction between 12.42 hour and 24 hour cycles accounted for 7% of salinity variance.

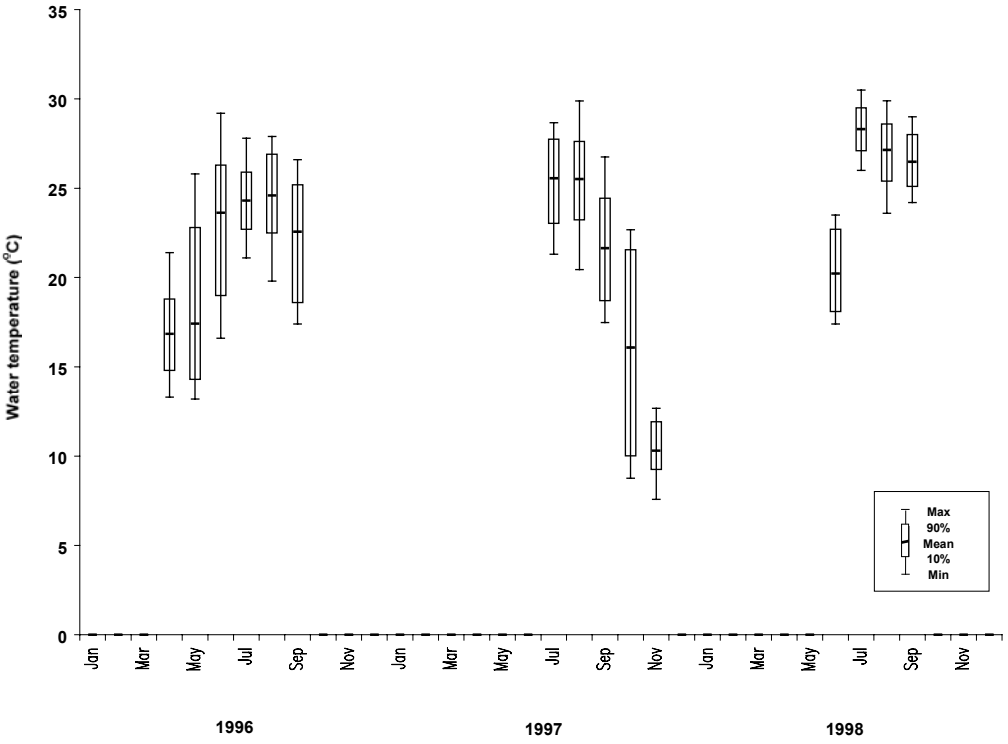


Figure 91. Water temperature statistics for Patuxent River Park, 1996-1998.

Thirty-one percent of dissolved oxygen (% saturation) data in 1996 were included in analysis; no dissolved oxygen data were collected in 1997-1998. Mean DO between Apr-Sep 1996 ranged from a low of 67% saturation (Apr) to a high of 102% saturation (Aug). Minimum (0% sat) and maximum (198.2% sat) DO were both recorded in Aug 1996. Hypoxia was observed in one month (Jul 1996) and persisted for 10.6% of the first 48 hours post-deployment (Figure 92). Supersaturation was observed in two months and persisted for 3.1% (May 1996) and 36.9% (Jul 1996) of the first 48 hours post-deployment. Scatter plots suggest strong fluctuations (20% sat) in daily DO cycles and even stronger fluctuations (50-200% sat) in bi-weekly DO cycles. Harmonic regression analysis attributed 40% of DO variance to 12.42 hour cycles and 30% of DO variance to both 24 hour cycles interaction between 12.42 hour and 24 hour cycles.

Photosynthesis/Respiration

Over three quarters (76%) of the data used to calculate the metabolic rates fit the basic assumption of the method (heterogeneity of water masses moving past the sensor) and were used to estimate net production, gross production, total respiration and net ecosystem metabolism (Table 23). Instrument drift during the duration of the deployments was not a significant problem at this site. Respiration rates exceeded production rates at Patuxent River Park; thus, the net ecosystem metabolism and P/R ratio indicated that this is a heterotrophic site (Figure 89). Temperature was significantly ($p<0.05$) correlated with gross production, total respiration and net ecosystem metabolism. Gross production and respiration increased as temperature increased, while net ecosystem metabolism became more autotrophic as temperatures increased. Salinity was not significantly ($p<0.05$) correlated with any metabolic measurement.

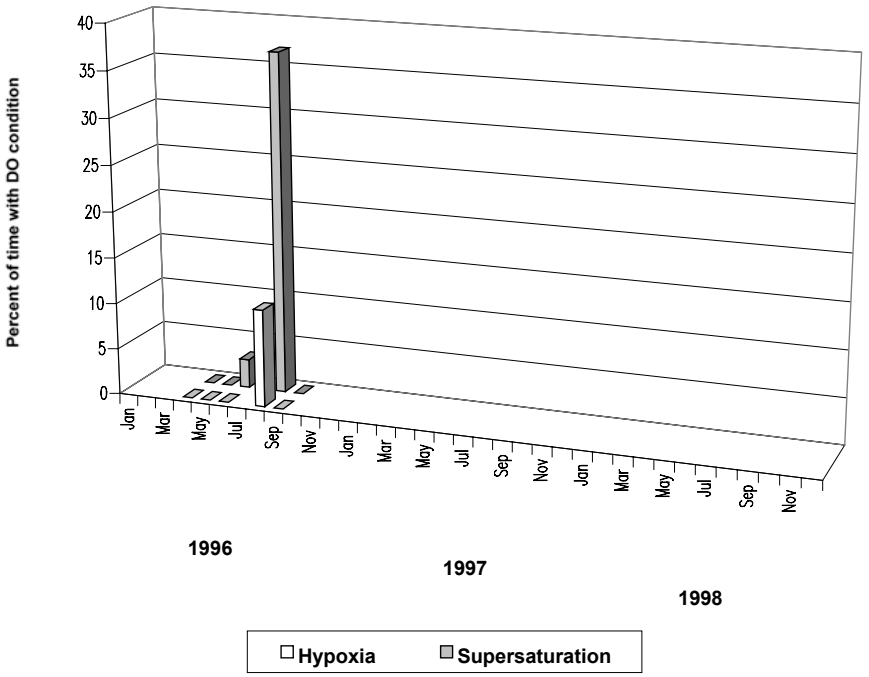


Figure 92. Dissolved oxygen extremes at Patuxent River Park, 1996-1998.

Table 23. Summary of metabolism data and statistics at Patuxent River Park, 1996-1998.

Patuxent River Park	mean	s.e.
Water depth (m)	2.41	
Net production $gO_2/m3/d$	0.46	0.14
Gross production $gO_2/m3/d$	3.04	0.25
Total respiration $gO_2/m3/d$	4.36	0.26
Net ecosystem metabolism g $O_2/m3/d$	-1.32	0.15
Net ecosystem metabolism g C/m2/y	-184	
P/R	0.70	
Statistical results		
Drift – paired t-test		
Gross production	ns	
Total respiration	ns	
Net ecosystem metabolism	ns	
Percent useable observations	76%	
Paired t-test on gross production and total respiration	$p<0.001$	
Correlation coefficient	Temperature	Salinity
Gross production	0.58	ns
Total respiration	0.43	ns
Net ecosystem metabolism	0.21	ns